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through an angle of  $180^\circ$ , and it will become the vector  $(+1)$ , or will be multiplied by  $(-1)$ ; that is,  $(-1)(-1) = +1$ . [F. P. Matz.]

## PROBLEMS.

56. Proposed by CHAS. E. MYERS, Canton, Ohio, and Hon. JOSIAH H. DRUMMOND, LL. D., Portland, Maine.

(a), How much can be paid for a bond, bearing 5% interest and having ten years to run, so as to realize 3% on the investment? [C. E. Myers]; (b), At what price must the government sell 5% \$100 bonds to run ten years, interest payable annually, to make them the same to the buyer as 3% bonds at par, to run ten years, interest payable annually, provided the buyer can invest all interest received at 4% interest payable annually? [J. H. D.]

57. Proposed by J. C. CORBIN, Pine Bluff, Arkansas.

Find the quotient of

$$\left| \begin{array}{cccc} (s-a_1)^2 & a_1^2 & a_1^2 & \dots \dots a_1^2 \\ a_2^2 (s-a_2)^2 & a_2^2 & a_2^2 & \dots \dots a_2^2 \\ a_3^2 & a_3^2 & (s-a_3)^2 & \dots \dots a_3^2 \\ \dots \dots \dots & \dots \dots \dots & \dots \dots \dots & \dots \dots \dots \\ a_n^2 & a_n^2 & a_n^2 & \dots \dots s-a_n^2 \end{array} \right| \div \left| \begin{array}{cccc} s-a_1 & a_1 & a_1 & \dots \dots a_1 \\ a_2 & s-a_2 & a_2 & \dots \dots a_2 \\ a_3 & a_3 & s-a_3 & \dots \dots a_3 \\ \dots \dots \dots & \dots \dots \dots & \dots \dots \dots & \dots \dots \dots \\ a_n & a_n & a_n & \dots \dots s-a_n \end{array} \right|$$

## GEOMETRY.

Conducted by B. F. FINKEL, Springfield, Mo. All contributions to this department should be sent to him.

## SOLUTIONS OF PROBLEMS.

45. Proposed by B. F. BURLISON, Oneida Castle, New York.

Determine the radius of a circle circumscribing three tangent circles of a radii  $a=15$ ,  $b=17$ , and  $c=19$ .

I. Solution by the PROPOSER; J. F. W. SCHEFFER, A. M., Hagerstown, Maryland; A. H. BELL, Hillsboro, Illinois; and F. P. MATZ, M. Sc., Ph. D., Mechanicsburg, Pennsylvania.

The problem has two cases: first, when the three given circles are tangent internally to the required circle, as in the problem; and, second, when the required circle is tangent to them externally. But *one solution* involving the resolution of a quadratic equation, will give the answers to both cases. We give the figure for the *first* case only.